DOW CORNING

High Performance Building
Solutions

Introduction to High Performance Insulation

AIA Course Number: 0DC008
AIA Learning Units: 1LU/HSW

GBCI CE Hours: 1
GBCI Course Number: 0090010891

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CONTINUING EDUCATION
AIA

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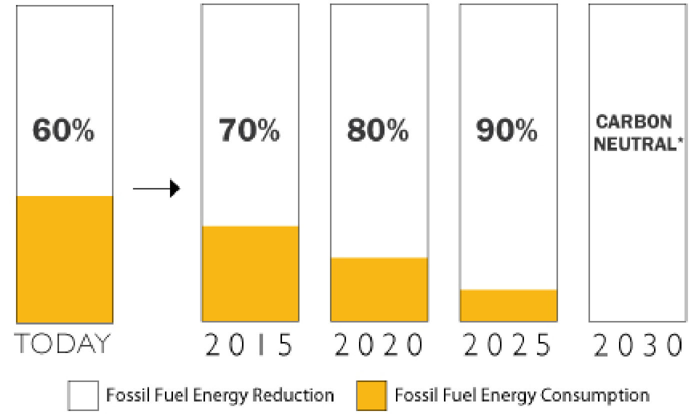
Learning Objectives

Upon completion of this course, participants will be able to:

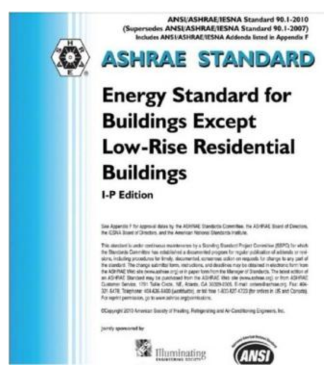
- Discover key properties of aerogel blanket insulation and vacuum insulation panels (VIP)
- Explain the results of recent thermal modeling and hot box testing of VIP in spandrel applications
- Describe the thermal and design benefits of vacuum insulation panels incorporated into an architectural insulation model for ease of constructability in curtainwall construction
- Recognize the benefits of recent thermal models to reduce thermal bridging using aerogel blanket to improve whole wall effective R values

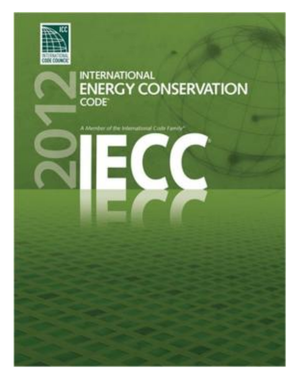
Energy Efficiency Codes & Regulations

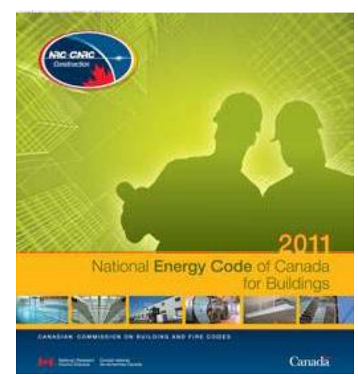
- IECC 2012
- ASHRAE 90.1
- ASHRAE 189.1
- SB10
- LEED v4.0
- Living Building Challenge
- Net Zero Buildings
- 2030 Challenge



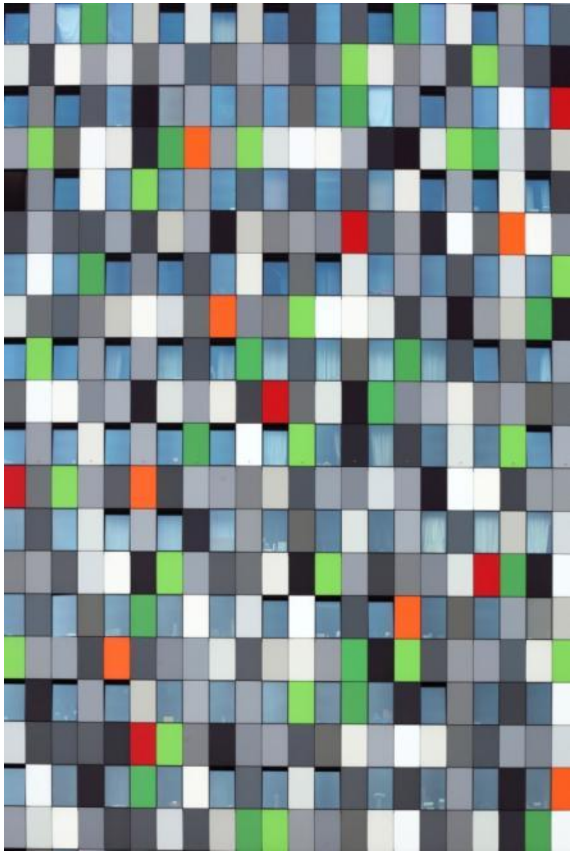
The 2030 Challenge

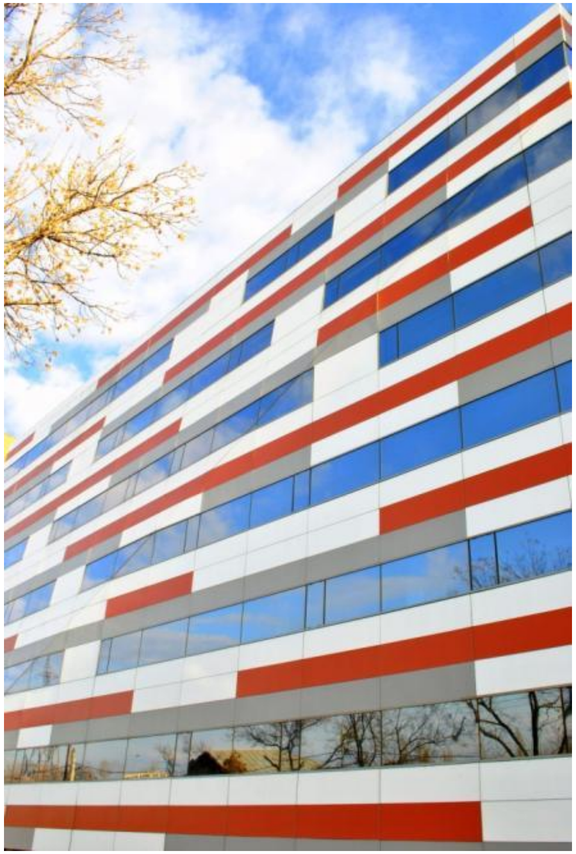


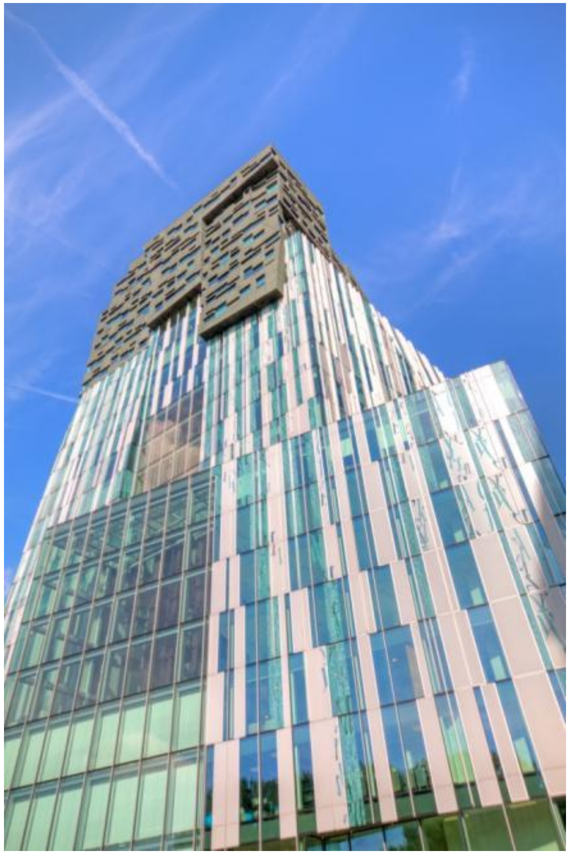




Designers Must Balance Energy Efficiency and Design Goals
Often a Trade-off Between Vision and Non Vision Area





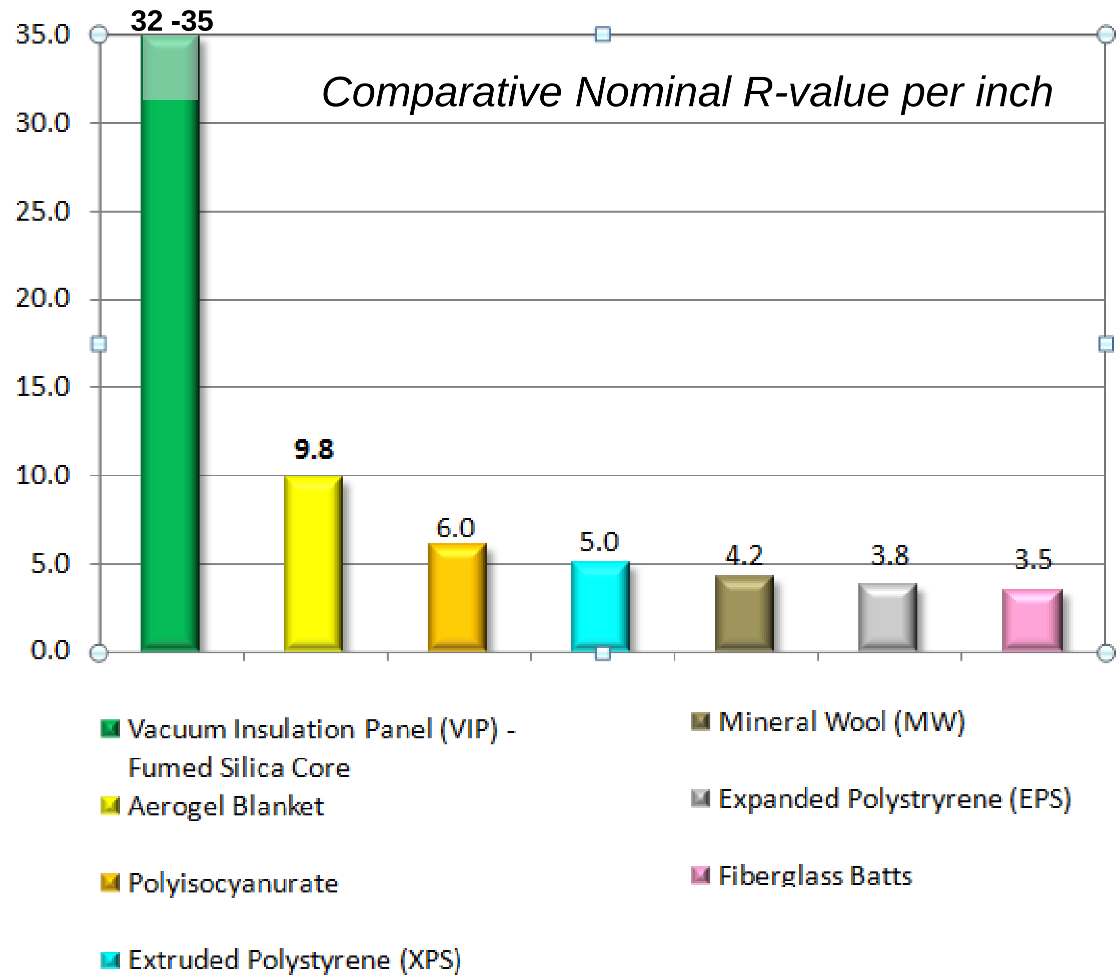


High Performance Insulation for Thinner Designs

Mineral Wool is 8 to 10x thicker to deliver an equivalent R-value to VIP

Aerogel Insulation Blanket
Flexible and Thin

High Performance Insulation Delivers a Step Change in Thermal Performance



New Technology such as Vacuum Insulation Panels (VIP) enable Greater Design Freedom

AV19344

Vacuum Insulation Panel Properties

- Advantages
  - Very low thermal conductivity (approx 4mW/mK COP)
  - Inherently moisture resistant
  - Excellent fire resistance of inorganic core
  - Good compressive strength
  - Thin profile vs. conventional insulations of equal R value.

- Design Limitations
  - Careful handling required
  - Cannot be cut to size. Customization of panels is required
  - If punctured thermal properties are reduced

Comparison of VIP Core Materials

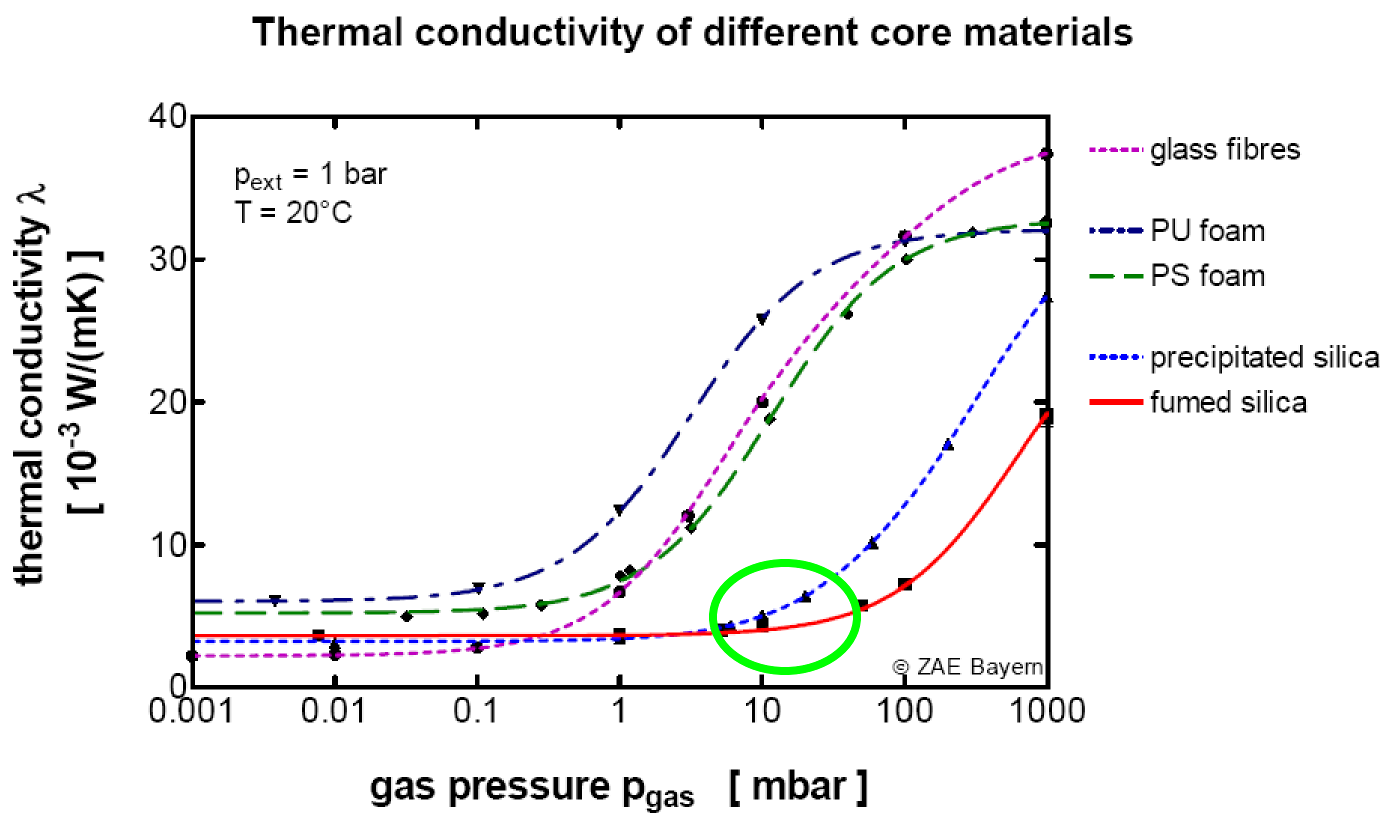
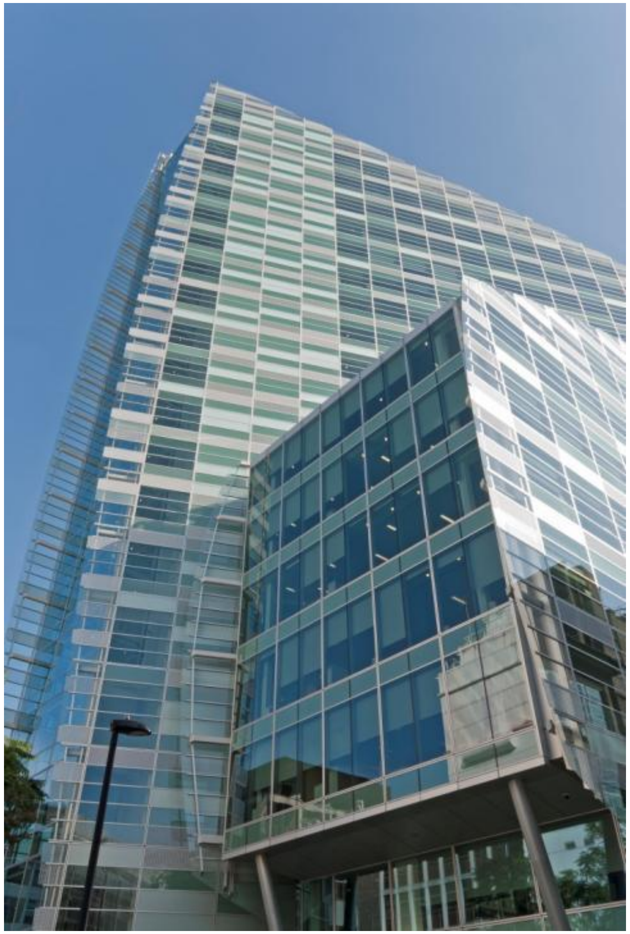


Figure 4: The heat conductivity of fumed silica starts to rise only above a gas pressure of more than 50 mbar.

VIP Enabled Spandrels Provide Superior Performance for Curtain Walls



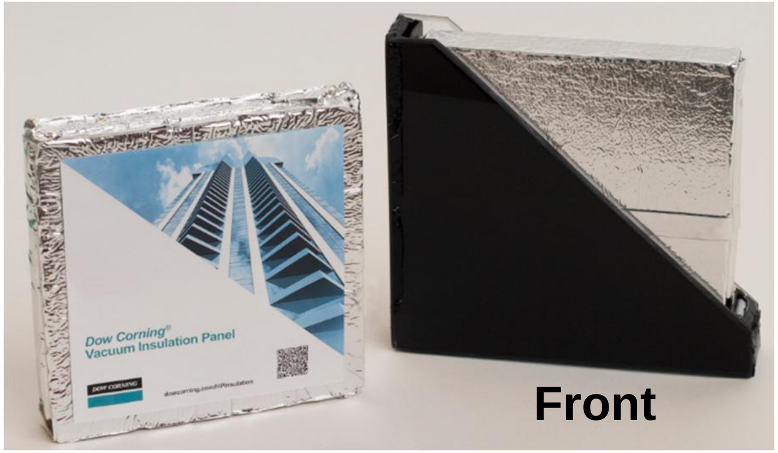
AV17400

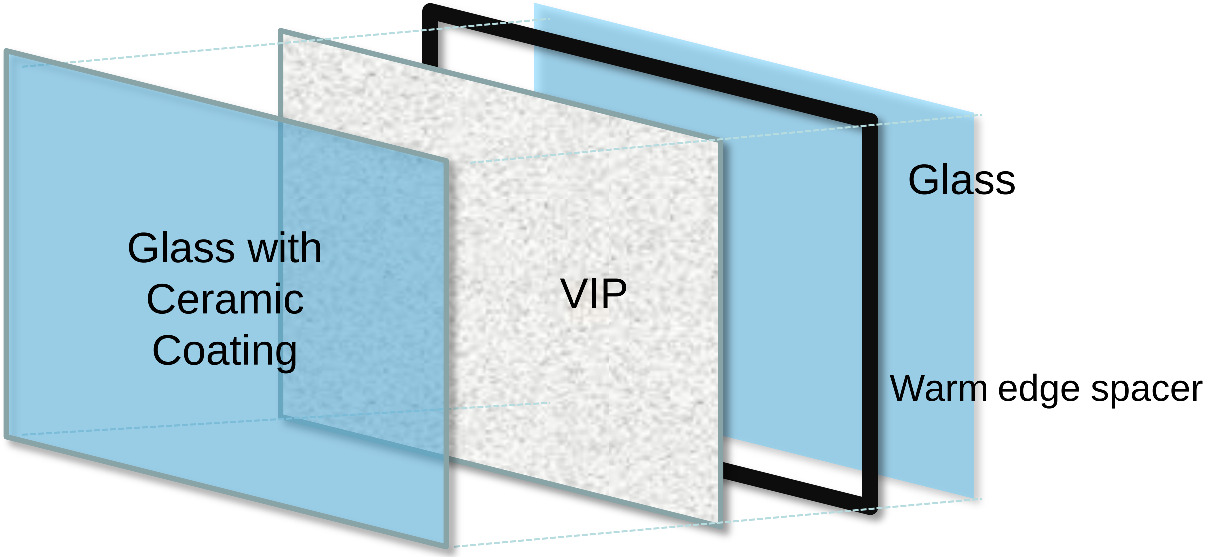
- Highest aesthetical and functional requirements
- Slim façade with high vision share requires lowest U-values for spandrels
- Spandrels with embedded VIP addresses need for easy installation and multiple design options

VIP integrated façade modules will enable high vision share while complying to thermal performance requirements

Product Concept: From VIP to AIM

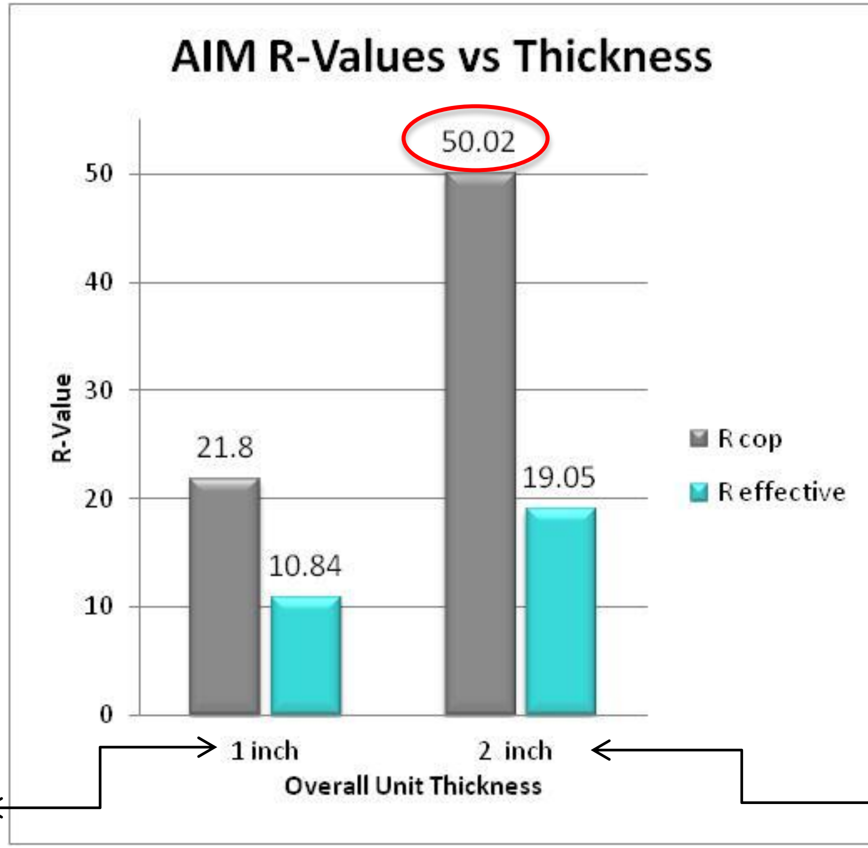
Architectural Insulation Module (AIM)
VIPs are installed in between two pieces of glass; aka Double Insulating Glass Unit





Curtainwall Application – Customized IG with Integrated VIP and Architectural Finish

VIP for Spandrel Panels Delivers a Step Change Improvement in Thermal Performance



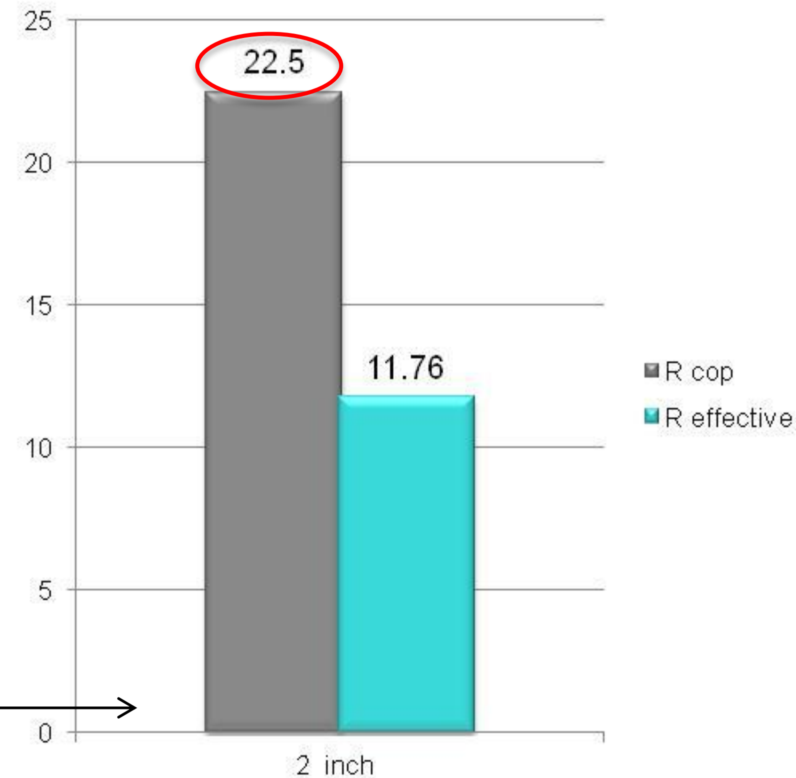
Fits in a
Standard Frame

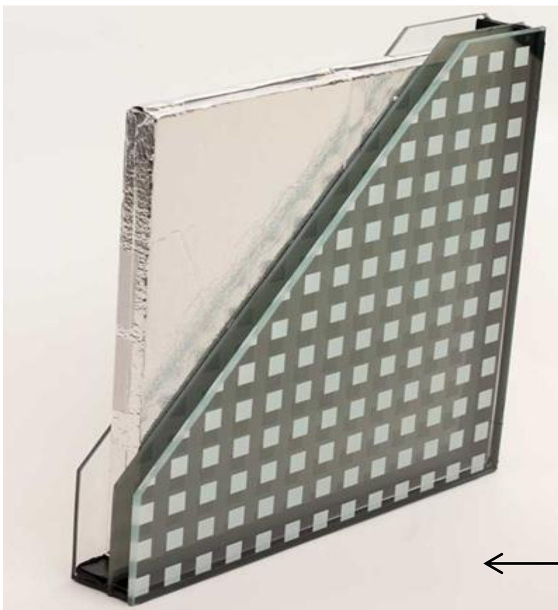
Fits in a Triple IGU Frame
Maximum Thermal Values

1 inch and 1 3/8 inch values modeled - LBNL THERM ® 7 , 2 inch unit test per ASTM C1363 hot box test.
AIM = VIP configured between glass with warm edge spacer

Visual Depth & Thermal Performance

R Values for AIM

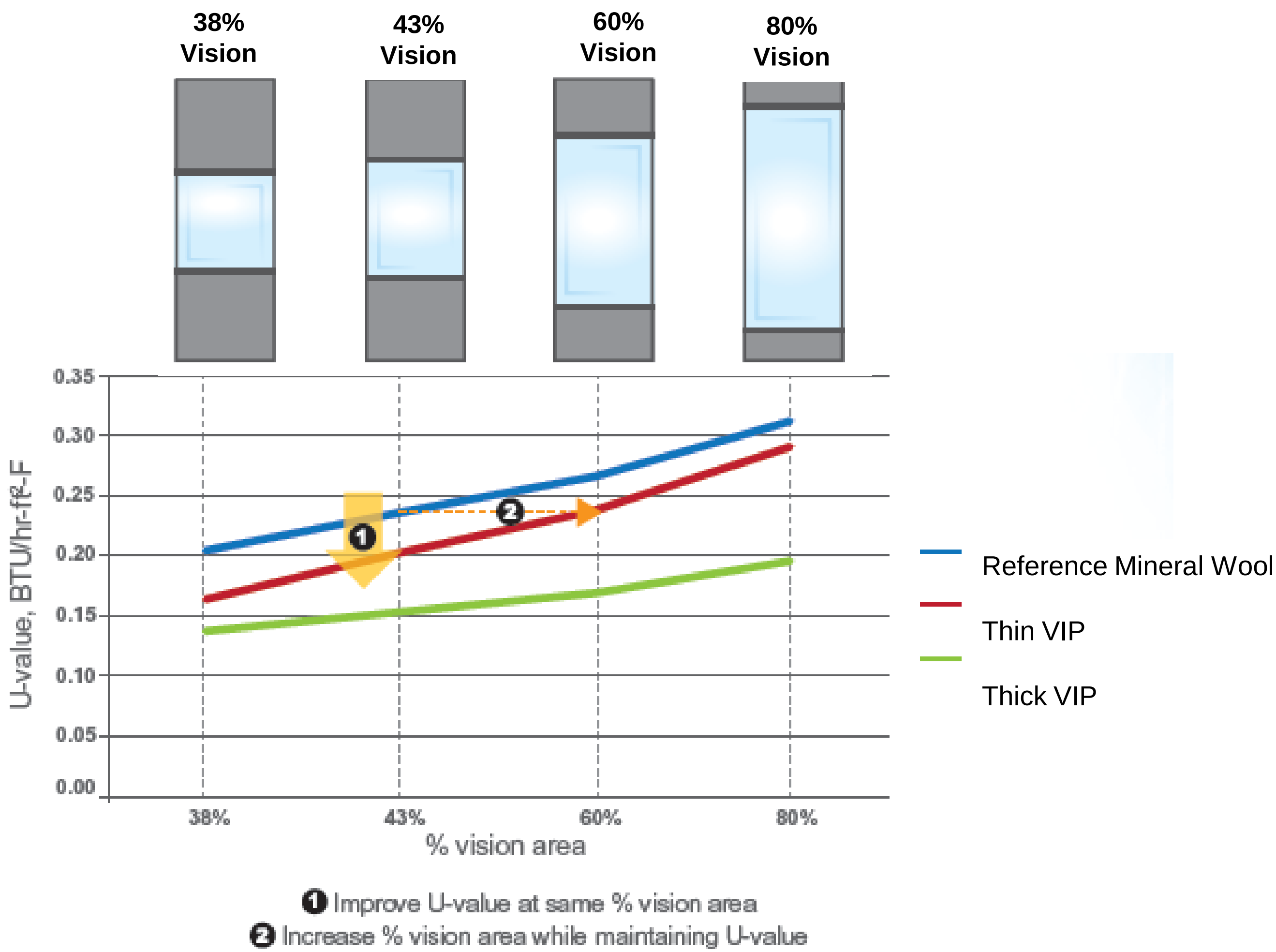




More Visual Depth
Provided with 3 Layers

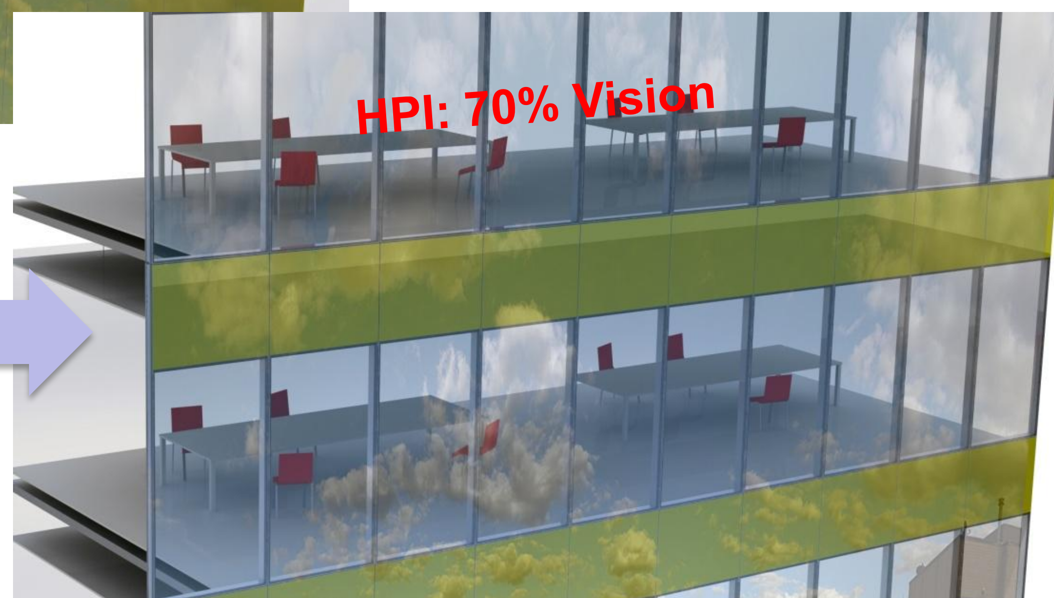
2 inch unit test per ASTM C1363 hot box test.
AIM = VIP configured between glass with warm edge spacer

VIP offers more Freedom to Achieve Lower U-Values and Meet Window to Wall Ratio Targets



Use of VIP Spandrel to Optimize Window to Wall Ratio and achieve U Value targets

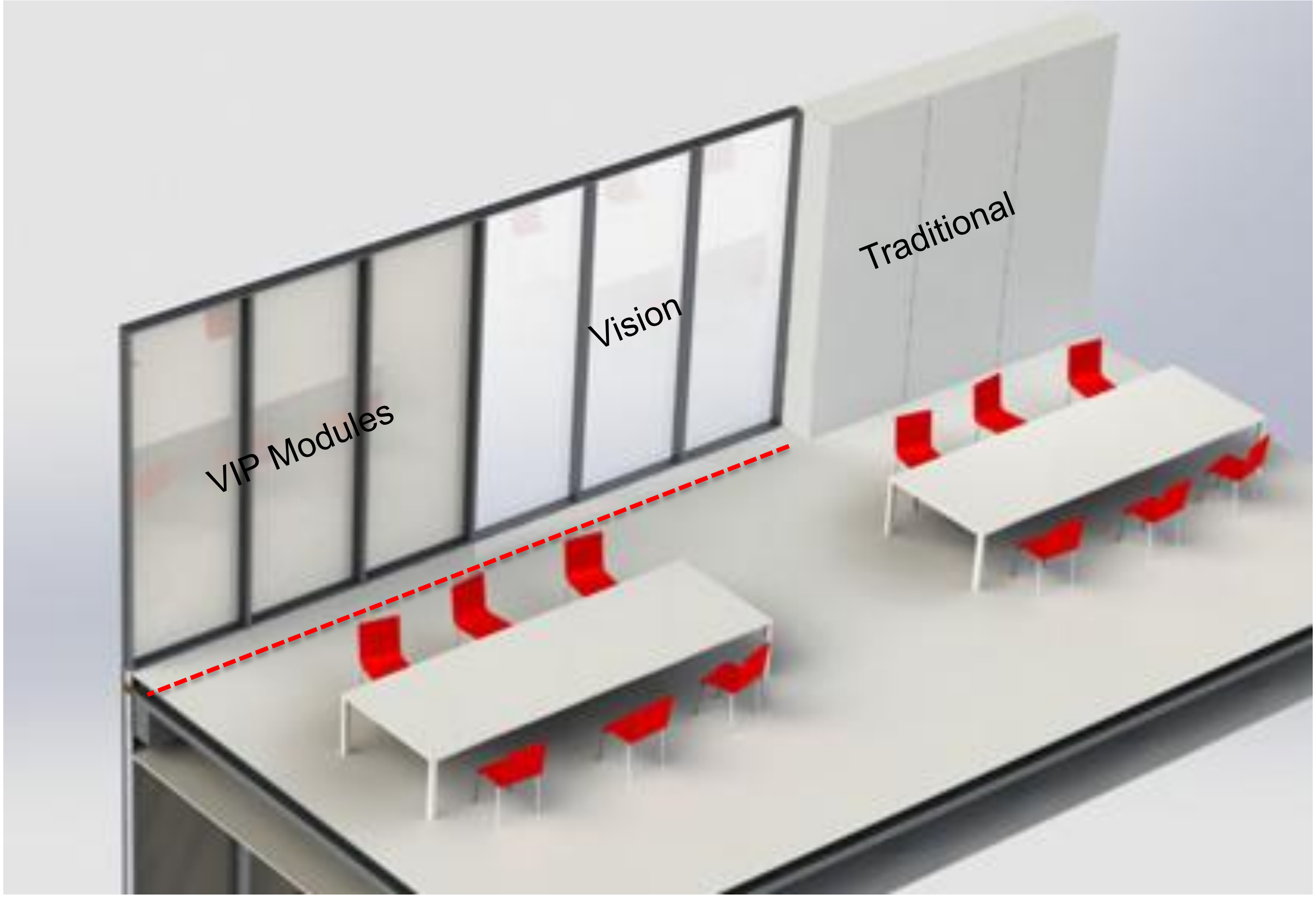
Improve U Value at Same Vision Area



Increase % Vision Area at Same U Value

Design VIP into the Vision Area to Maximize Thermal Performance

Designs with VIP Façade Modules to Increase Useable Floor Space



Thermal Modeling Shows Reduced Condensation Risk

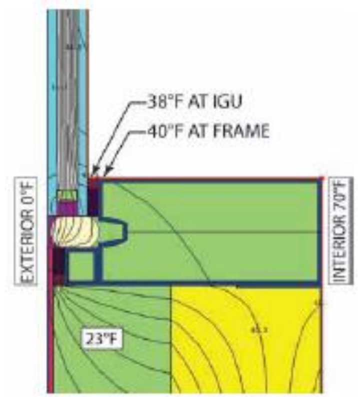


Fig 8: Double IGU and Mineral Wool

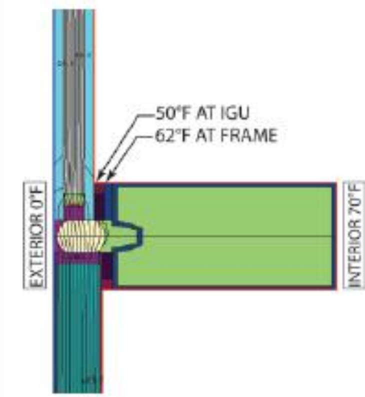


Fig 10. Double IGU and VIP

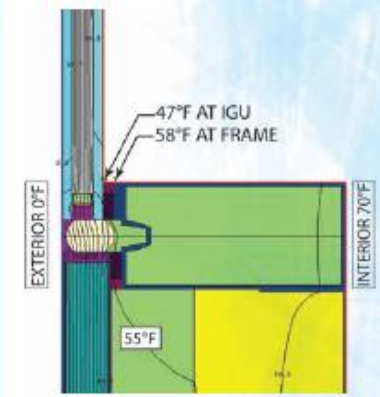


Fig 12: Double IGU and VIP + Mineral Wool

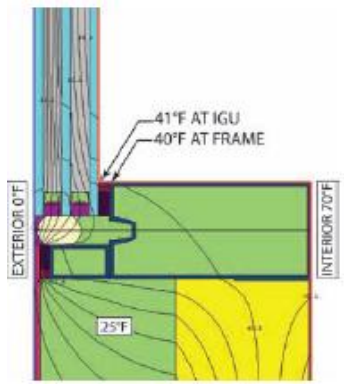


Fig 9: Triple IGU and Mineral Wool

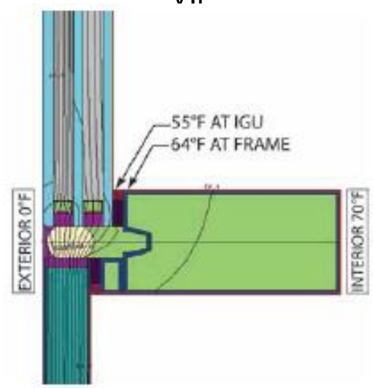


Fig 11: Triple IGU and VIP

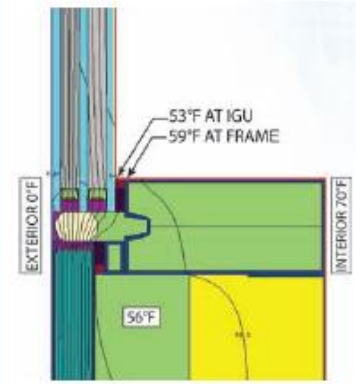


Fig 13: Triple IGU and VIP + Mineral Wool

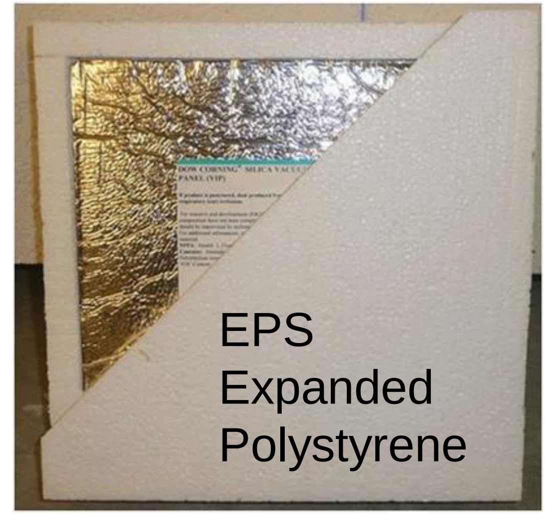
	Fig. 8	Fig. 9	Fig. 10	Fig. 11	Fig. 12	Fig. 13
Glass	Double-Pane IGU	Triple-Pane IGU	Double-Pane IGU	Triple-Pane IGU	Double-Pane IGU	Triple-Pane IGU
Spandrel	MW	MW	VIP	VIP	VIP + MW	VIP +MW
Cold Point Glass	38°F	41°F	50°F	55°F	47°F	53°F
Cold Point Frame	40°F	40°F	62°F	64°F	58°F	59°F
Maximum RH for No Condensation	**31%**	**34%**	**49%**	**59%**	**43%**	**55%**

Selected applications

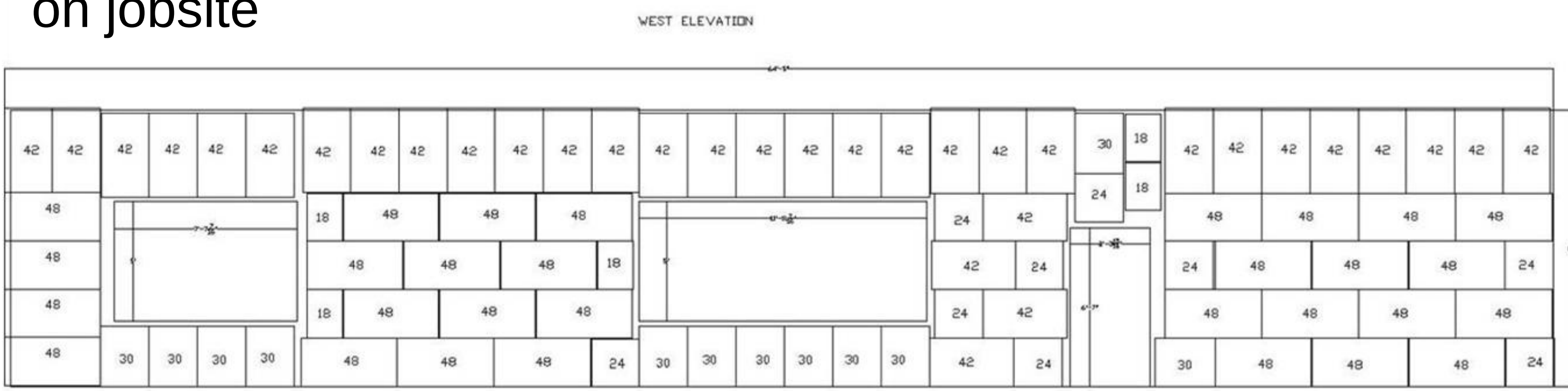
Vacuum Insulation Panels

Architectural Insulation Modules

Encapsulated VIP - Field Trial (DOE Project)
Maine



- Layout used to guide placement of panels on jobsite



Facade Retrofit Without Full Replacement
United Kingdom

<u>Challenge</u>:

Maintain aesthetics and look of an historical building while increasing thermal performance in prevailing space constraints

<u>Solution</u>:

17mm (0.67 inch) VIP installed in glass spandrel

Spandrel Glass in Sliding Glass Doors
London, UK

Spandrel Glass in Curtain Wall
Alaska

Spandrel Glass in Curtain Wall
Michigan

Ease of Installation into Conventional Glazing Systems

VIP Panels Used in Vision Area Create a Slim Vision Wall with High Thermal Performance

VIP Encapsulated in Rainscreen Design
Belgium

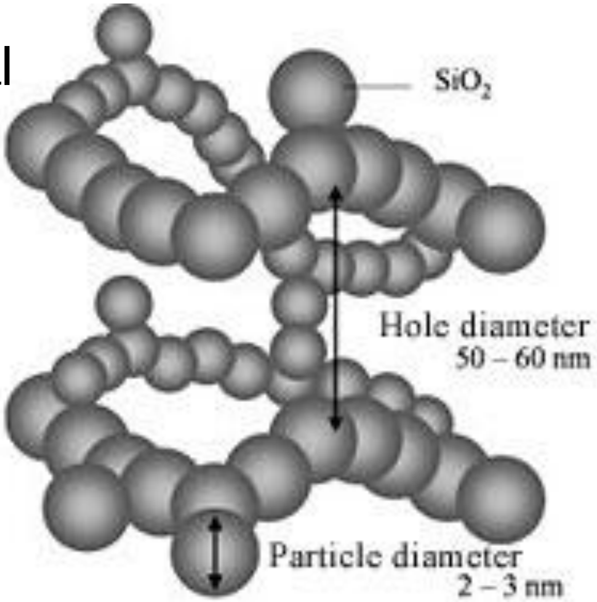
Improving the Building Envelope

Addressing Thermal Bridging

Aerogel Building Insulation Blanket

Aerogel Technology

- Invented in the 1930's
- Synthetically produced amorphous silica gel
- Nanoporous structures that minimize thermal transport - low thermal conductivity
- An aerogel is composed of 95-99% air, making it one of the lightest existing materials.
- Aerogel started its applications in aerospace and expanded in many fields
- Manufactured and sold in a blanket form



Thin Profile, Flexible, Insulating Blanket
A Simple Solution for Thermal Bridging

- Significantly increase thermal resistance in space limited situations
- Enable new design possibilities
- Easy to install in difficult profiles such as curves and corners
- Fast installation with simple tools
- Environmentally safe
- Fire resistant
- Hydrophobic
- Does not settle over time
- ASTM C1728 Standard Specification for Flexible Aerogel Insulation

Thermal Bridging

"…the heat flow through a poor-performing detail, like an exposed concrete slab edge, could account for over 40% of the heat flow through the building envelope. In comparison, a thermally efficient detail, such as insulated slab edge, could contribute less than 10%..."

Journal of Building Enclosure Design, issue Winter 2013, Article: ***"Thermal Bridging: Ignorance is Bliss"*** *By, Mark Lawton & Neil Norris of Morrison Hershfield, Ltd.*

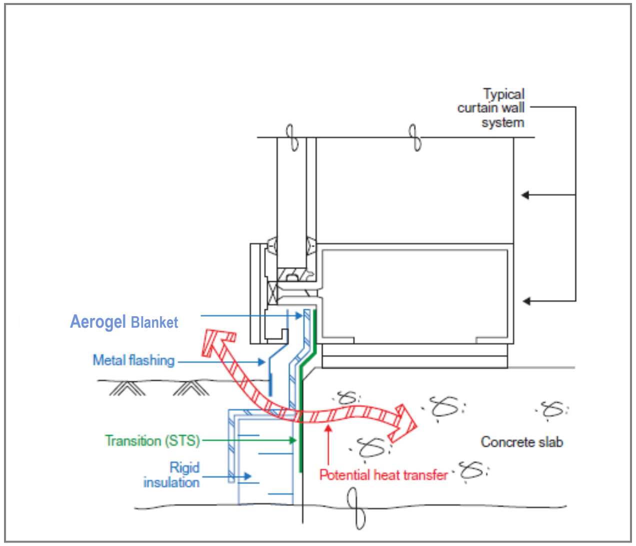
An Evaluation of Thermal Performance
Looking at Three Details

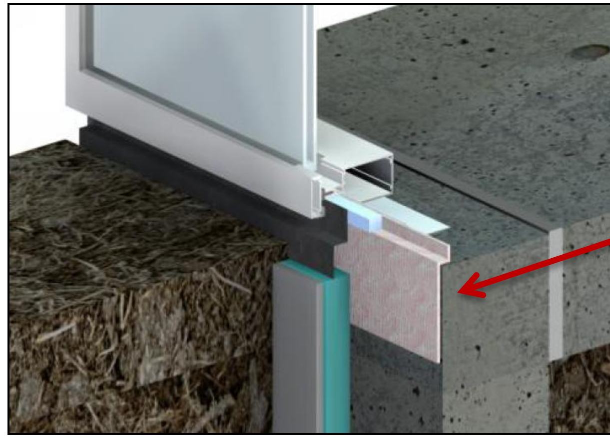
1. Curtain-wall at-grade detail with the Building Insulation Blanket applied to the neck of the curtain-wall to the below grade rigid insulation

2. Curtain-wall jamb at the exterior and interior insulated steel stud assembly with the Building Insulation Blanket applied around the adjacent steel stud and at the wall to curtain-wall transition

3. Rehabilitated window-wall system with the Building Insulation Blanket at the slab edge and around glazing vertical and horizontal mullions.

1. Curtain Wall to At-Grade Slab Transition





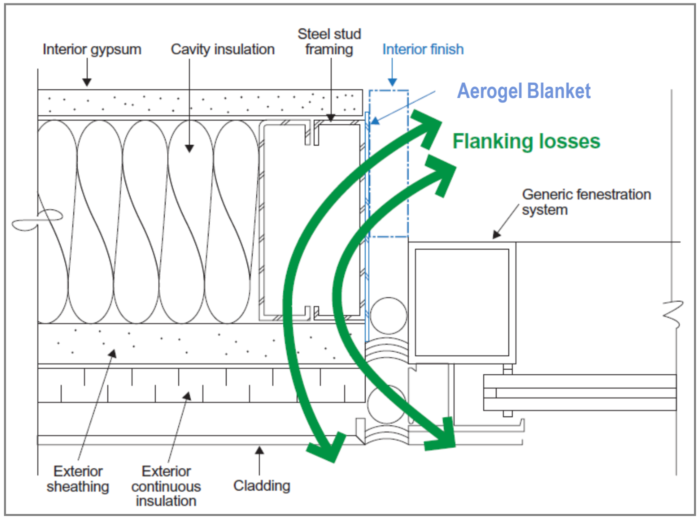
Aerogel Building Insulation Blanket was placed to cover the neck of the curtain-wall to the below-grade insulation

Without Building Insulation Blanket

Perimeter heat loss for curtain-wall at-grade by varying U-values

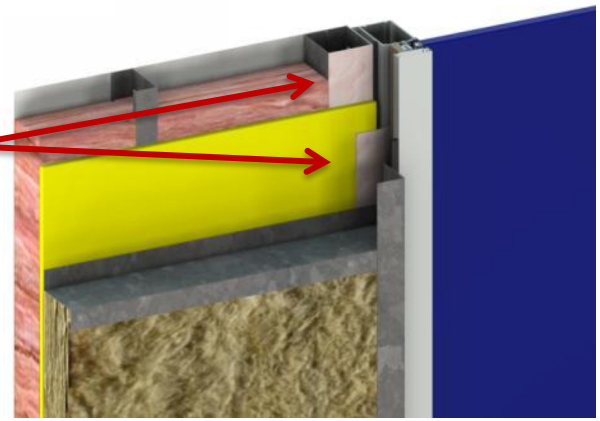
Depth of Insulation	Below Grade Insulation (hr·ft^2·^{o}F/BTU)	Slab Perimeter heat Loss (BTU/hr·ft·^{o}F)		% Reduction in Heat Loss
		Without Building Insulation Blanket	10mm Building Insulation Blanket	
24”	R-10	0.495	0.370	**25%**

2. Curtain Wall to Exterior/Interior Insulated Steel Stud Wall Transition

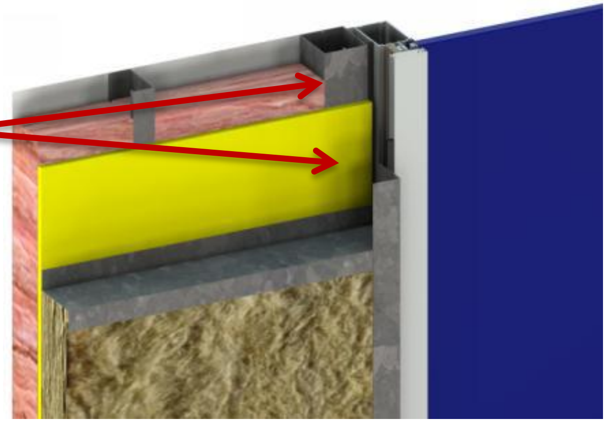


Building Insulation Blanket was added in two locations:

1. Around the interior steel studs adjacent to the curtain mullion
2. Bridging between the curtain-wall neck to the exterior sheathing.



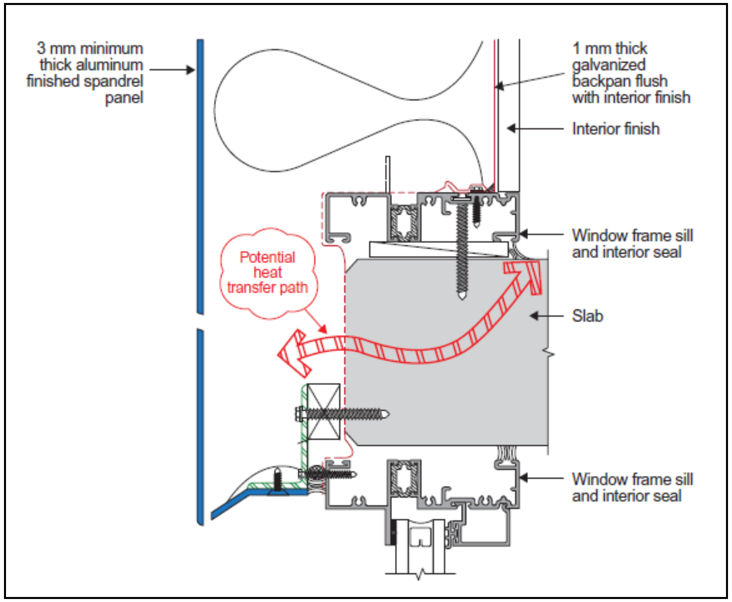
Without Aerogel Insulation Blanket

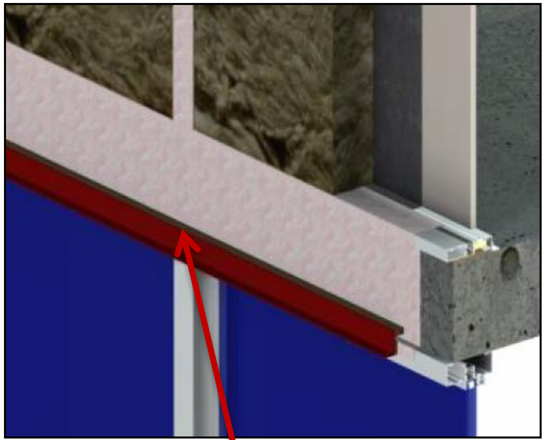


Linear Transmittance calculations for Steel Stud Wall transition

Transmittance Description	Linear Transmittance (BTU/hr·ft·°F)		% Reduction
	Without Building Insulation Blanket	10mm Building Insulation Blanket	
Curtain-wall jamb to an interior and exterior insulated steel stud assembly	0.069	0.019	73%

3. Window-Wall at Floor Slab





Aerogel Building Insulation Blanket was modeled over the slab face and both the horizontal and vertical mullions

Without Aerogel Building Insulation Blanket

Linear Transmittance calculations for a Window-wall Spandrel Section Slab face

Transmittance Description	Linear Transmittance (BTU/hr·ft·°F)		% Reduction
	Without Building Insulation Blanket	10mm Building Insulation Blanket	
Window-wall spandrel section	0.556	0.264	53%

Thermal Models

Show a 25% to 75% reduction of Heat Loss by Reducing Thermal Bridging

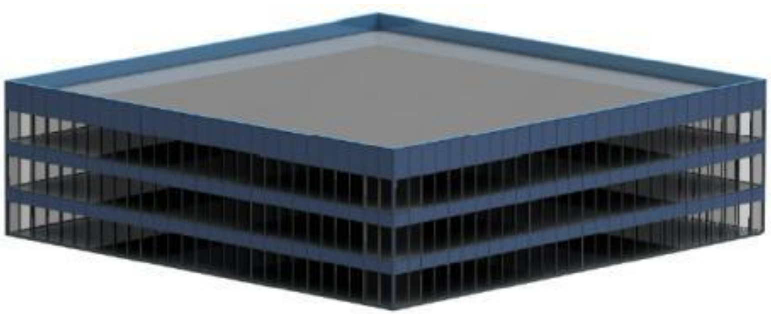
Detail	Transmittance Description	Linear Transmittance (BTU/hr·ft·°F)		% Reduction
		Without Building Insulation Blanket	10mm Building Insulation Blanket	
1	Curtain-wall at grade	0.495	0.370	**25%**
2	Curtain-wall jamb to an interior and exterior insulated steel stud assembly	0.069	0.019	**73%**
3	Window-wall at floor slab	0.556	0.264	**53%**

Whole Building Energy Models

Show 3-7% Energy Savings by Reducing Thermal Bridging

Table 14: Annual Heating Energy Savings for Chicago Climate

Building Scenario	Assembly Performance	Annual Heating Energy Use MMBtu (GJ)		Savings due to Aerogel Details	
		With Aerogel	Without Aerogel	Absolute MMBtu (GJ)	Percent (%)
Scenario 1: Façade with Glazing System covering 100% the Façade Area	Conventional Assemblies	5,905 (6,230)	6,123 (6,460)	218 (230)	3.56%
	Higher Performance Assemblies	4,275 (4,511)	4,421 (4,665)	147 (155)	3.31%
Scenario 2: Façade with curtain-wall glazing and a Steel Stud Wall Assembly	Conventional Assemblies	4,279 (4,515)	4,545 (4,796)	266 (281)	5.85%
	Higher Performance Assemblies	3,114 (3,285)	3,340 (3,524)	227 (239)	6.78%



Scenario 1

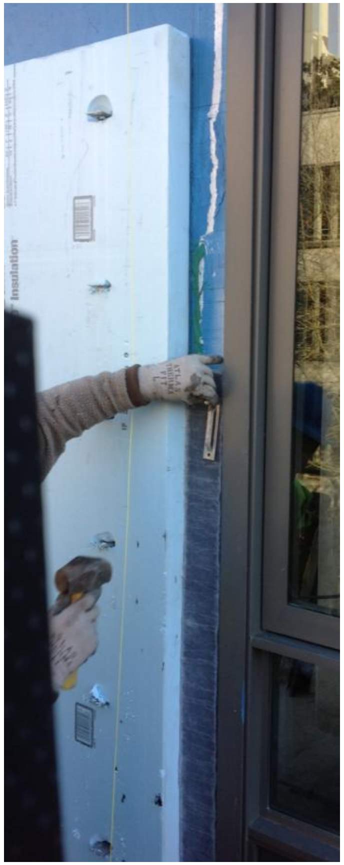
Scenario 2

Selected applications

Building Insulation Blanket

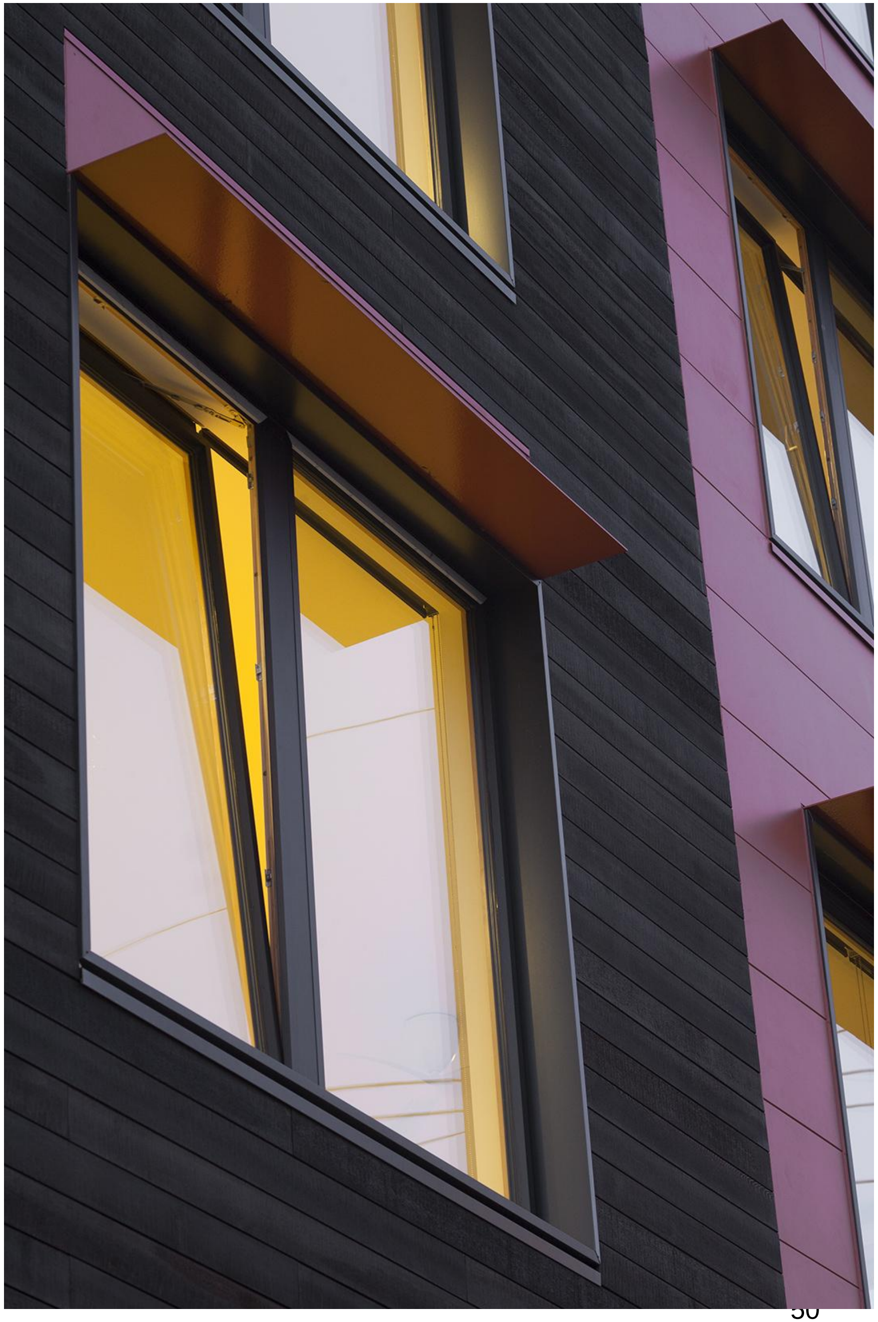
Space Constrained Locations

Easy to use, environmentally safe, thin material that offers freedom of design and improved energy efficiency

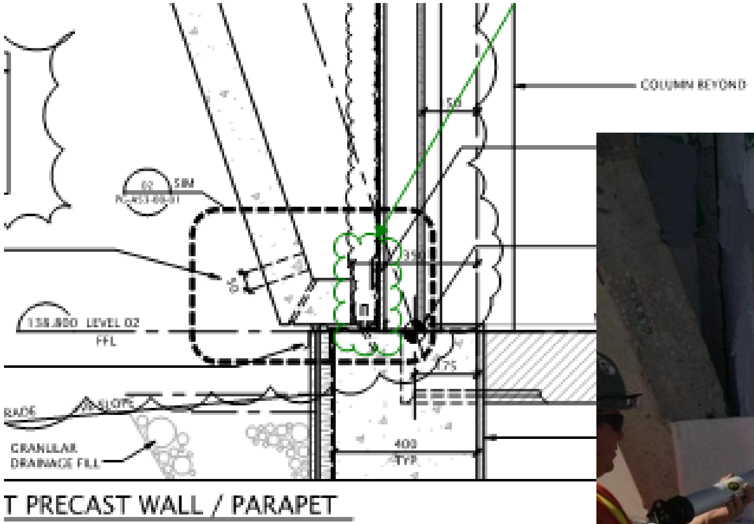


Thermal Separator
Oregon

Completed Project



Space Constrained Transitions
Ontario



Questions ?

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New Innovations from *Dow Corning*

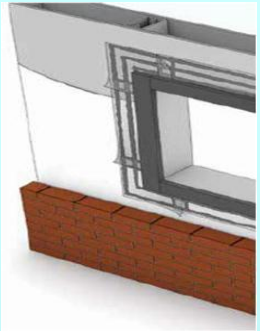
DOW CORNING® BRAND
HIGH PERFORMANCE
INSULATION

Dow Corning® Architectural Insulation Module

Dow Corning® HPI 1000 Building Insulation Blanket

Dow Corning® 121 Structural Glazing Sealant

BUILD A BETTER
BARRIER



Dow Corning® DefendAir 200

Dow Corning® STS

Dow Corning® 758 Weather Barrier Sealant

Thank You

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Specifications Information:

- www.dowcorning/HPInsulation
- www.buildabetterbarrier.com
- www.dowcorning.com/construction
- www.dowcorning.com/758
- www.dowcorning.com/121sgs
- http://www.dowcorning.com/content/construction/product_specifications_americas.aspx

Continuing Education Courses

Introduction to High-Performance Insulation (HPI)
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 0DC008
1 GBCI CE Credit; GBCI Course Number: 0090010891

The course provides an overview of high-performance insulation technology, including vacuum insulation panels, aerogel blanket insulation, thermal bridging, thermal and design benefits, and design applications.

Air Barrier Systems: Silicone Solutions to Reduce Building Air Infiltration
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 0DC009
1 GBCI CE Credit; GBCI Course Number: 0090011086

The course defines types of air barriers and describes the different solutions currently on the market for sealing penetrations and transitions to create a complete air barrier system. It provides an overview of the basic requirements air barriers must meet and identifies key areas within a wall system where detailing is important to system success.

Thermal and Energy Modeling of Two Fenestration Systems in Hot and Cold Climates
1 AIA/CES Learning Unit, HSW Credit, SD Credit; AIA Course Number: 0DC007/DE-0DC007

The course studies the energy efficiency of commercial curtainwall systems in hot and cold climates and compares a range of curtainwall systems, including various glass and IG spacer components. It reviews whole-building energy consumption, including carbon dioxide emissions, and compares frame temperatures, U-values and SHGC under various conditions.

Proven Performance of Structural Silicone Glazing (SSG)
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 0DC006

The course reviews silicone sealant chemistry. Through modeling, it explains the thermal benefits of structural silicone glazing applications. It explains silicone reliability; the standards and test methods involved in validating the durability of structural silicones; test methods related to meeting specifications and codes; SSG joint design, including structural bite and glueline thickness calculations; reglazing of in-service structures; and requirements for quality control.

Continuing Education Courses

Silicone Sealants and Coatings for Building Construction and Restoration
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 0DC002/DE-0DC002
1 GBCI CE Credit; GBCI Course Number: 90011164

The course explains the differences between silicone and organic sealant chemistries, the functions of nonstructural and structural glazing sealants, how to select appropriate sealing systems for new construction and renovation applications, and the appropriate designs for structural versus weathersealing sealant joints.

Construction Sealant Aesthetics
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 0DC005

The course identifies key sealant qualities and factors impacting sealant aesthetics, how sealant type and formulation specifics can impact sealant aesthetics, and the differences between silicone and modified silicone polymer sealants.

Determining the Cause of Joint Failure
1 AIA/CES Learning Unit, HSW Credit; AIA Course Number: 00DC004

The course identifies procedures used to evaluate sealant performance in the joint, types of sealant failure and the causes of a failed joint, as well as the validity of manufacturers' product data and performance claims.

Silicone Sealants for Structural and Protective Glazing
1 AIA/CES Learning Unit, HSW Credit, AIA Course Number: 0DC003

The course defines and explains the purpose of silicone structural and protective glazing; how protective glazing systems work; appropriate

CONTINUING EDUCATION AIA

GBCI CMP